II. *Observations at Sea.*

Under this head three distinct investigations have been made, as follows;

(*a.*) From an examination of the results obtained by chronometric longitude expeditions, we find that for a voyage of 15 days the average error is 5.3^s; the range between the greatest and the least results in each series is 18.0^s; the latter value has a range between 1.5^s and 55.0^s, and the coefficient is 3.4.

(*b.*) The longitudes of 36 stations have been determined by various British naval expeditions. The chronometers were rated at the Greenwich Observatory before starting, and the observations for time at the terminal stations were made in the usual way with the sextant. Evidently more than usual care was taken both with the observations and reductions, We find that the average difference between the results obtained by different chronometers is 4.4 miles with a range of 15.1 miles. The average range between the different results for longitude is 5.0 miles with a range of 31.6 miles. The average number of chronometers was 11, and the average duration of voyage was 11 days.

(*c.*) During the spring and summer of 1880 Officer W. H. Bacon, of the Cunard steamer "Scythia," kindly undertook for me a series of systematic observations from which the relative errors could be determined with considerable certainty. A complete series for a single day consisted of five sights at intervals of fifteen minutes, about 8 o'clock in the morning, five sights in the neighborhood of 11 o'clock, and five sights at the corresponding hours in the afternoon. Observations were also made when the ship was in known positions as often as possible.

This series of observations has an exceptional value on account of the conscientious fidelity with which the programme was adhered to and of the skill with which they were made. The relative errors were determined by comparing each position with the mean of the series, the rate being determined both from the morning and afternoon observations and from the log.

The results obtained are found in the following table:

Limits in Miles.	Average Error from Observations at 9^h and 3^h.	Average Error from Log at 9^h and 3^h.	Average Error from Observations at 11^h and 1^h.	Average Error from Log at 11^h and 1^h.	Difference between Observation and Log at 9^h and 3^h.	Difference between Observation and Log at 11^h and 1^h.
	No. Cases.	No. Cases.	No. Cases.	No. Cases.	No. Cases.	No. Cases.
0.0- 0.5	1	0	0	0	7	6
0.5- 1.0	9	6	2	3	1	2
1.0- 1.5	8	13	3	5	3	3
1.5- 2.0	4	5	3	3	3	2
2.0- 2.5	6	4	6	5	2	3
2.5- 3.0	2	1	3	4	1	0
3.0- 3.5	2	2	6	5	7	2
3.5- 4.0	4	1	4	5	1	2
4.0- 5.0	1	3	6	5	4	4
5.0- 6.0	0	0	2	1	1	5
6.0- 7.0	0	0	2	1	2	2
7.0- 8.0	1	1	0	1	1	1
8.0- 9.0	2	0	1	1	0	2
9.0-10.0	0	1	0	0	1	2
10.0-11.0	0	0	0	0	1	1
11.0-12.0	0	0	0	0	2	1
12.0 +	1	1	0	0	0	0

QUERY.

A SUBSCRIRER would like to know the best method of mounting Triple phosphate crystals (dry) so as to tack them to the slide without interfering with definition. —Replies invited.

ON THE ACTION OF BACTERIA ON VARIOUS GASES.*

By F. HATTON.

The experiments were made to ascertain the nature of the action exerted by various gases on the life and increase of bacteria, and to observe what influence the bacteria had on the percentage composition of the gases. The bacteria were obtained by shaking fresh meat with distilled water. The aqueous extract was filtered and exposed to the air for twenty-four to thirty-six hours; it was always found to be full of bacteria. A small flask was half filled with mercury, filled up with the bacteria solution, and inverted in a mercury trough. The gas under examination was then passed up, a small glass vessel was introduced under the mouth of the flask, and the whole removed from the trough. The liquid was examined daily as to the condition of the bacteria, the sample being removed by a piece of bent glass tubing having an india rubber joint. After about a week the gas was pumped out by means of a Sprengle and analyzed. Atmospheric air was first tried. The bacteria lived well during the fifteen days of the experiment (T. 15° to 22°). A large absorption of oxygen took place, but it was not replaced by carbonic anhydride; in a second experiment (T. 25° to 26·50) 20 per cent. of the oxygen disappeared, and only 17 per cent. of CO_2 was formed. Pure hydrogen after fourteen days had no action on the bacteria; the gas contained 0.34 per cent. CO_2, 98.94 per cent. H. Pure oxygen after ten days was converted into CO_2 29.98 per cent., O 70.02 per cent. A mixture of CO 46.94 per cent., CO_2 1.27, O 1.27, N 50.51, was next tried after fourteen days; the gas contained CO_2 17.77, CO 0.55, H 7.58, CH_4 2.50, N 71.57. In all of the above cases the bacteria flourished well. Cyanogen was next tried. The solution of meat turned gradually to a thick black fluid. On the fifth day very few bacteria could be seen. From this time, however, they increased, and on the twelfth day were comparatively numerous. On the fifteenth day the gas was analyzed; it contained CN 5.35, CO_2 57.59, O 2.24, N 34.79; a second experiment gave similar results. It appears, therefore, that cyanogen is fatal to bacteria as long as it exists as such, but that it soon decomposes into ammonic oxalate, &c., and that the bacteria then revive, especially in sunlight. Sulphurous anhydride was next tried; the bacteria lived during the fifteen days: the gas contained CO_2 7.87, O 0.00, N 2.13, SO_2 90.10. Similar results were obtained with nitrogen, nitrous oxide, nitric oxide, carbonic anhydride, a mixture of H and O obtained by the electrolysis of water and coal gas. In all cases the bacteria lived well during the experment. The author next experimented with a solution of urea (0.98 per cent.) and phosphate of potash (0.4 per cent.), sowing it with bacteria. The bacteria lived well during the fourteen days of the experiment; small quantities of gas were evolved containing 0.53 per cent. CO_2, 2.64 per cent. O, and 96.82 per cent. N. An experiment was made with spongy iron, air, and bacteria. On the fourth day, all the bacteria had vanished; the air was analysed on the fifth day, and consisted of CO_2 0.26, O 0.00, and N 99.74 per cent. Experiments were also made with acetylene, salicylic acid, strychnine (10 per cent.), morphine, narcotine, and brucine; none of these substances had any effect on the bacteria. On the other hand, phenol, spongy iron, alcohol, and potassium permanganate were very destructive to these microscopic growths.

Mr. W. M. HAMLET said that these experiments confirmed some observations of his own. He had found that bacteria could exist in almost anything—in carbonic oxide, hydrogen, 1 per cent. creosote, phenol, methylamin, methylic alcohol, chloroform. Moreover, Crace-Calvert had shown that they could live in strong carbolic acid. In

* Read before Chemical Society, March 3, 81. This paper obtained for the author the Frankland Prize of £50 at the Institute of Chemistry.